Chapter 2: Background

Chapter Contents

2.1 Overview of the Watershed

The Mystic River watershed is a collection of rivers, streams, lakes and ponds that drain an area of approximately 76 square miles north of Boston. (See Figure 2-1.) The watershed is a subwatershed of the Boston Harbor, and the Mystic River watershed in turn includes a number of distinct subwatersheds.

The system was formed in large part by retreating glaciers more than 10,000 years ago, and is relatively flat. Originally, the system was tidal all the way up to the Lower Mystic Lake. Construction of the Craddock Dam in 1908 near Medford Square prevented the flow of salt water to Alewife Brook and the portion of the Mystic River upstream of the dam. The Amelia Earhart Dam was constructed in 1966 between Everett and Somerville, just below the confluence of the Malden and Mystic Rivers. This dam created a freshwater basin that enhanced public recreation opportunities, and provided for flood control. The dam again altered the watershed's hydrology, and separated the watershed into a freshwater system above the dam and a saltwater system below the dam that empties into the harbor.

As land uses in the watershed have developed, substantial portions of the waterbodies have been straightened and sometimes culverted. In some locations, the rivers and streams are no longer visible, and alteration of the river courses has profoundly affected their characteristics.

The next section of this chapter describes the nine subwatersheds that comprise the larger Mystic River watershed. The following section discusses the history of the watershed, as context for understanding the source of past contamination of the waters. The final section of this chapter describes the cities and towns that are included in the watershed.

2.2 Description of Subwatersheds

For purposes of this report, we have defined nine subwatersheds within the larger Mystic River watershed, as described below.

***Aberjona subbasin**:* The Aberjona is the largest subbasin in the Mystic watershed, comprising ~25% of the total watershed area. The nine-mile-long Aberjona River originates in Reading and flows south through Woburn and Winchester before discharging into the upper forebay of Upper Mystic Lakes (see Figure 2-2).[1] Along its course, the Aberjona receives inflows from Halls Brook, North Woburn Creek, Snyder Creek, Sweetwater Brook, and Horn Pond Brook (which drains the Horn Pond subbasin). The Aberjona is relatively slow moving and meandering in spots, particularly in north Woburn and Winchester Center, where there are many wetland areas and shallow ponds. There are two branches of the Aberjona River, north and south, in Winchester.

[1] The subbasin maps in this chapter include the locations of hazardous waste sites and water sampling sites, which are discussed in Chapter 5.

Horn Pond Subbasin: The two largest surface waterbodies in the watershed are Horn Pond in Woburn and Wedge Pond in Winchester (see Figure 2-3). Woburn draws ~60% of its municipal water from wells located on the west side of Horn Pond; therefore, land-uses in the subbasin (particularly right around the pond) are carefully controlled. Wedge Pond, located near Winchester center, is used for recreational activities (swimming and boating) and is impacted by stormwater runoff.

Mystic Lakes Subbasin: Upper and Lower Mystic Lakes were created in c.1873, when a dam was built at what is now the outlet of the upper lake. The upper lake is ~25 meters at its deepest point and contains two shallow forebays at its northern end where the Aberjona River discharges. The lower lake is also about 25 meters at its deepest point. Until 1908, when the Craddock Dam was built in Medford Center, the lower lake was tidal. A layer of saltwater is still present at the bottom of the lower lake, which may be impacting water quality in upper water layers. Both lakes are widely used for recreation, including fishing, boating and swimming. The Medford Boat Club owns a motorboat dock on the lower lake, and on the upper lake there are two more boat clubs, a public boat ramp and two swimming beaches (one public, one private). A map of the lakes and the surrounding watershed area is shown in Figure 2-4.

Mill Brook Subbasin: Mill Brook is fed by Sickle Brook, Munroe Brook (via the Arlington Reservoir) and Great Meadows. (See Figure 2-5) Sickle Brook and Munroe Brook drain farmlands in the southern part of Lexington. As it moves through Arlington Heights, Mill Brook is fed by steeply sloping uplands before reaching more gentle terrain near Arlington Center. Just before discharging into Lower Mystic Lake, the brook passes through a constructed wetland area adjacent to the Arlington Cemetery. For a ~1 km stretch upstream of the constructed wetland (between Grove Street and Mystic Avenue), the brook is culverted underneath several playing fields. Previously, this stretch of the brook sustained a series of seven mill-ponds. The brook is not much used for recreational purposes, as it is difficult to gain access to it along much of its length.

Mystic River 1 Subbasin: The Mystic River 1 subbasin contains the portion of the Mystic River (and its contributing watershed area) that lies between Lower Mystic Lake and the Amelia Earhart Dam (see Figure 2-6). This section of the Mystic receives significant inflow from Lower Mystic Lake, Alewife Brook, and the Malden River, as well as minor inflows from Two Penny Brook and Town Meeting Brook in Medford.

Until c.1908 when the Craddock Dam was constructed in Medford Square, the Mystic River was tidal all the way up to the Lower Mystic Lake. After the construction of the Amelia Earhart Dam in 1967, the Craddock Dam was taken offline; however, a portion of the dam remains in place and can act as a constriction during high flows. Flow out of this section of the Mystic is controlled by daily releases at the Amelia Earhart Dam. The dam is equipped with several large, diesel-powered pumps, which serve to prevent flooding by pumping water into the saltwater section of the Mystic (Mystic River 2) before and during significant precipitation events.

This part of the Mystic River – especially downstream of Medford Square – is widely used by recreational boaters. The reach contains two yacht clubs and a rowing club, as well as the Blessing of the Bay Boathouse, where the Boys & Girls Club runs youth programs.

Alewife Brook Subbasin: Alewife Brook drains parts of Arlington, Belmont, Cambridge, and Somerville (see Figure 2-7). The main tributary to the Alewife, Little River, is fed by Little Pond in Belmont and Spy Pond in Arlington. Another important tributary is Wellington Brook, which is fed by Clay Pit Pond in Belmont. The topography of the subbasin is mixed: the uplands in Belmont and western Arlington are fairly steep, while parts of Cambridge and East Arlington are relatively flat, making these areas particularly susceptible to flooding (see Figure 4-7).

Many changes in the surface hydrology and hydraulics have been made in this subbasin, some of them to address flooding and public health risks. For example, in the late 1800's sewage pipes were constructed in Cambridge and Somerville to carry wastes directly into the Alewife. Later, in the 1930s when a wastewater treatment plant was built in Boston, many of the old discharge pipes were converted into combined sewage overflows (CSOs). Because the sewage system was designed to carry both sanitary sewage and stormwater, CSOs were needed to prevent excess stormwater from backing-up into homes during heavy rainstorms. Although many of the CSOs have since been removed or redesigned to surcharge less frequently, eight CSOs are still present – seven in Cambridge and one in Somerville.

The Craddock Dam (Medford Square) was designed to alleviate flooding in the Alewife area and combat periodic outbreaks of malaria (Freeman, 1904). The operation of the Craddock, and its later replacement, the Amelia Earhart Dam, greatly reduced the rate of water movement in the brook. The combined effect of the CSO discharges and sluggish flows make the Alewife one of the most polluted waterbodies in the Mystic watershed.

Spy Pond is a "Great Pond" of the Commonwealth, and covers over 102 acres. The state filled in some 20 acres of the pond in the 1970s as part of the project to widen Route 2.

Malden River Subbasin: The Malden River originates in Melrose and flows south through Malden, Everett and Medford before discharging into the Mystic River (Figure 2-8). Spot Pond Brook, which receives discharges from Spot Pond in Stoneham, is a tributary to the Malden. Since the 1950s, the Malden has been altered along much of its length. North of Malden Square, the river was deepened and widened to increase discharge capacity and minimize local flooding. This alteration left the channel bank very steep along this reach, and so a chain-link fence was constructed on both sides of the river to discourage access. At Malden Square, the river was piped underground to prevent flooding of the city center. Between Malden Square and the confluence with the Mystic, the river was straightened and dredged to allow barge traffic (Nagle Consulting Associates, 1999). The banks of the Malden are heavily developed, particularly below Medford Square, where much of the land is zoned for industrial activity. Flow in the lower portion of the river (below Malden Square) is controlled by the Amelia Earhart Dam.

Mystic River 2 Subbasin: The Mystic River 2 subbasin extends from the Amelia Earhart Dam to its discharge into Boston Harbor. This reach of the river is tidal and is composed of saltwater except for inputs of freshwater from the Mystic River from upstream of the dam, from Island End River, and from Chelsea Creek (see Figure 2-9). Land-use and water-use in the subbasin are markedly different from upstream of the dam. About 44% of the land in the subbasin is used for

industry and transportation (vs ~10% upstream of the dam) and of the remainder only ~16% is open space (vs. ~32% upstream of the dam).

Many industries occupy riverfront properties, including a major coal/oil-fired power station (Sithe Mystic), a gypsum-processing plant, a natural gas facility, and a shipping terminal. Large, ocean-going cargo ships, which deliver oil, coal, liquefied natural gas, gypsum, automobiles and other products, are major users of the river. Recreational boaters also use the river as a means of getting from yacht clubs to Boston Harbor. Much of the waterfront in the subbasin is a Designated Port Area, which limits land uses to waterfront-dependent activities.

Despite its industrial character, the river supports many species of fish as well as marine mammals. For example, large populations of herring and alewives run upriver each spring to spawn, and they are fed upon by striped bass and harbor porpoises, the latter of which have been sighted many times in recent years (Jim Rice, New England Aquarium, personal communication, 2002).

Chelsea Creek Subbasin: Mill Creek, the headwaters to Chelsea Creek, rises out of a wetland area along the Revere/Chelsea border, runs due east and then turns 90 degrees to the south where it becomes Chelsea Creek. The Chelsea/Mill Creek system drains parts of Everett, Revere, Chelsea, and East Boston before discharging to the Mystic River just upstream of Boston Harbor (Figure 2-10). The Chelsea Creek subbasin is one of the most urbanized in the Mystic watershed. Only 9.5% of the subbasin is preserved as open space, compared to 27% for the watershed as a whole.

Much of the land along Chelsea Creek is zoned for industrial use and transportation, which greatly limits local access to the river. For example, there are several fuel tank-farms in Chelsea and East Boston that are served by barges and large, ocean-going tanker vessels. Like the lower Mystic, Chelsea Creek waterfront is a Designated Port Area.

2.3 History of the Watershed

The Mystic River watershed has been settled for hundreds of years. The name “Mystic” is derived from the Indian “Missi-Tuk” or “great tidal river”, reflecting the Mystic River’s original status as a tidal river. For hundreds of years, Native Americans lived and fished along the Mystic. The area was settled by Europeans in the 1600s, and one of the Mystic area’s first European settlers was Massachusetts Bay Colony Governor John Winthrop. He built his summer retreat, the Ten Hills Farm, on the banks of the Mystic.

Human activities along the banks of the Mystic and its tributaries have had profound impacts on the watershed’s hydrology and water quality for many years. Native Americans and later Colonists used weirs to catch alewives as fertilizer for their crops. During the 1800s, factories replaced many farms, and the region attracted many new residents. By 1865, overfishing and pollution had all but eliminated commercial fishing.

Shipbuilding on the Mystic dates from earliest Colonial times and peaked in the 1840s. Schooners and sloops transported timber, molasses for rum distilleries, and other products, on the trade route between Medford and the West Indies. In 1631, the first ship built by Europeans in Massachusetts, the “Blessing of the Bay,” was launched from the shores of the Mystic River. During the 19th

century, 10 shipyards along the Mystic River built more than 500 clipper ships. Later, railroads and then a system of roadways replaced the river as a transportation route.

The waters of the Mystic were harnessed to power tide mills from early Colonial days until the end of the 19th century. Tide mills were built throughout the length of the Mystic on both sides of the shore. Their waterpower was used to grind grain and spices, saw wood, and process paints, cloth and other products. Mills, brickyards and tanneries along the river brought wealth, but some industries caused significant pollution of the waterways. Today, a mix of residences, businesses, active and abandoned industrial facilities, and parks border the River.

The history of the Aberjona subwatershed illustrates the effect of industrialization on local water quality. The subwatershed was settled by Europeans in the mid-1600s. For over 300 years, leather tanning and finishing was a prominent industry, especially in Woburn. Between 1838 and 1988, tanning and finishing took place at 54 sites in Woburn (Durant et. al., 1990). Other industries in the subwatershed included chemical manufacturing, rendering, and tool and machine-making. Contamination of local waterbodies, including Horn Pond and Russell Brook, began being reported in the 1870s. Use of Upper Mystic Lake as a water supply for communities in the lower watershed was discontinued in 1898, due to the contamination. (Durant and Abbasi, 2000). Chemical manufacturing was a significant source of water quality problems. Over time, seven different companies operated at the IndustriPlex site in Woburn, manufacturing sulfuric acid, lead arsenate pesticides, glue, and other products. This facility and others contributed substantial loadings of lead, arsenic and chromium to the local waters, and the sediments in the Aberjona are still contaminated by these toxic metals. IndustriPlex eventually became a major Superfund site, as did the Wells G & H site which gained notoriety in the book “A Civil Action.” Both of these sites are located in Woburn.

The history of the Alewife Brook subbasin illustrates earlier residents’ view that alterations of the natural state of the waterways represented desirable progress. During the late 1800s and early 1900s, mosquitoes living in the wetlands and stagnant ponds contributed to numerous cases of malaria. Actions taken to address the malaria problems included filling in ponds, straightening and deepening Alewife Brook to improve flow, and construction of the Craddock Dam, to eliminate saltwater intrusion. Eliminating the tidal action also made former wetlands available for road and residential development (Durant and Abbasi, 2000). As noted earlier, these actions had a major effect on the area’s hydrology and water quality. The subbasin’s waters were also contaminated by sewage and tannery wastes, and the Alewife was the site of clay-brick manufacturing.

While many of the historical changes in the watershed have had adverse impacts on its natural resources, there are now opportunities to reverse some of this damage. Direct discharges of pollution have been reduced dramatically by federal and state regulation, and non-point sources of pollution are now getting increased attention from state and local governments and watershed advocates. The decline of industry in some parts of the watershed presents an opportunity to reclaim some of the land lost to industrial sites and restore open space and wildlife habitat. As abandoned and underused sites are redeveloped for commercial and residential uses, there is an opportunity to adopt Best Management and Low Impact Development Practices, to reduce water use, stormwater pollution, and flooding, to reclaim open space, and to improve wastewater management.

2.4 Profile of Watershed Communities

Demographics

The Mystic is the most densely populated and urbanized watershed in Massachusetts, and includes numerous environmental justice communities. Table 2.1 shows population density for the communities in the watershed, ranging from Somerville (18,000 people per square mile of land area) to Wilmington (1,200 people per square mile.) All communities in the watershed are more densely populated than the statewide average (800 people per square mile.) Note that separate data are not available for Charlestown and East Boston, which are neighborhoods of Boston. Both are among the more densely populated areas in the watershed, however.

Table 2-1 Population and Population Density

	Land Area (sq. miles)	Population 2000	Population Density (persons per sq. mile land area, 2000)
Massachusetts Total	7,840.02	6,349,097	809.8
Arlington	5.18	42,389	8,179.6
Belmont	4.66	24,194	5,190.2
Burlington	11.81	22,876	1,936.4
Cambridge	6.43	101,355	15,766.1
Chelsea	2.19	35,080	16,036.8
Everett	3.38	38,037	11,241.1
Lexington	16.40	30,355	1,851.0
Malden	5.07	56,340	11,102.9
Medford	8.14	55,765	6,851.3
Melrose	4.69	27,134	5,779.8
Reading	9.93	23,708	2,388.3
Revere	5.91	47,283	7,994.2
Somerville	4.11	77,478	18,868.1
Stoneham	6.15	22,219	3,614.1
Wakefield	7.47	24,804	3,321.6
Watertown	4.11	32,986	8,025.7
Wilmington	17.13	21,363	1,247.0
Winchester	6.04	20,810	3,346.3
Winthrop	1.99	18,303	9,208.3
Woburn	12.67	37,258	2,939.6

Table 2.2 provides information on the income and racial/ethnic characteristics of the watershed's communities, and Table 2.3 shows information on immigrant status and English language capabilities. Table 2.2 shows a substantial range in median annual household incomes among the watershed's communities, from over $96,000 in Lexington to $30,000 in Chelsea. Six communities (including Boston as a whole) had more than 10 percent of their residents living below the poverty

level in 1999, and Chelsea had more than 20 percent living in poverty. Watershed communities with substantial Black or African-American, Asian, or Hispanic/Latino populations include Chelsea, Boston as a whole, Cambridge, Everett, Malden and Somerville.

Table 2.3 shows that there are substantial immigrant populations in the same communities, as well as in Revere and Watertown. More than 20 percent of the populations in Boston, Everett, Malden, Revere, Somerville, and Woburn, and more than half the population in Chelsea, speak English "less than well".

Watershed communities that are characterized by low income, a high proportion of immigrant residents, and/or a high proportion of minority residents often suffer from disproportionate exposure to pollution and lack of access to environmental amenities. An updated 2005 study of environmental justice problems in Massachusetts identified 20 communities that are "most intensively overburdened" by cumulative environmental hazards per square mile.[2] Of the 20, ten are located in the Mystic River watershed. While this study addressed air pollution and hazardous waste sites, it is likely that a similar study of water-related problems and access to open space and recreational amenities would show the same disproportionate impacts on environmental justice communities. Figure 2-11 shows the communities in the watershed that have been designated as EJ communities under the state's Environmental Justice policy.

[2] Faber and Krieg, 2005.

Table 2.2: Community Socio-Economic, Racial and Ethnic Characteristics

Community	Median Household Income ($, 1999)	Per Capita Income ($, 1999)	Percent Unemployed*	Percent of Individuals Below Poverty Level 1999	Percent of Population			
					White**	Black or African-American**	Asian**	Hispanic/ Latino***
Massachusetts Total	50,502	25,952	4.6	9.3	84.5	5.4	3.8	6.8
Arlington	64,344	34,399	2.2	4.1	91.0	1.7	5.0	1.9
Belmont	80,295	42,485	2.3	4.4	91.2	1.1	5.8	1.8
Boston@	39,629	23,353	7.2	19.5	54.5	25.3	7.5	14.4
Burlington	75,240	30,732	2.7	1.9	86.7	1.4	10.6	1.3
Cambridge	47,979	31,156	6.1	12.9	68.1	11.9	11.9	7.4
Chelsea	30,161	14,628	7.3	23.3	57.9	7.3	4.7	48.4
Everett	40,661	19,845	5.0	11.8	79.7	6.3	3.2	9.5
Lexington	96,825	46,119	2.5	3.4	86.1	1.1	10.9	1.4
Malden	46,315	22,004	4.0	9.2	72.1	8.2	14.0	4.8
Medford	52,476	24,707	3.6	6.4	86.5	6.1	3.9	2.6
Melrose	62,811	30,347	2.0	3.3	95.2	0.9	2.0	1.0
Reading	77,059	32,888	1.9	2.6	96.5	0.4	2.2	0.8
Revere	37,067	19,698	5.9	14.6	84.4	2.9	4.5	9.4
Somerville	46,315	23,628	3.5	12.5	77.0	6.5	6.4	8.8
Stoneham	56,605	27,599	21	4.1	95.0	0.9	2.5	1.8
Wakefield	66,117	30,369	3.1	3.1	96.9	0.4	1.4	0.8
Watertown	59,764	33,262	2.4	6.3	91.4	1.7	3.9	2.7
Wilmington	70,652	25,835	1.5	1.9	96.3	0.4	2.0	1.0
Winchester	94,049	50,414	2.4	2.6	93.1	0.7	4.6	1.0
Winthrop	53,122	27,374	4.1	5.5	94.4	1.7	1.1	2.7
Woburn	54,897	26,207	3.0	6.1	90.6	1.9	4.8	3.1

@ Includes entire city; only East Boston and Charlestown are in the watershed.
*Percent of civilian labor force 16 years old and over.
** Excludes persons who report two or more races. Communities with more than 2 percent reporting two or more ones race include Boston (4.4%), Cambridge (4.6%), Chelsea (6.6%), Everett (5.4%), Malden (3.5%), Medford (2.3%), Revere (3.8%), and Somerville (4.8%).
***Of any race.
Source: U.S. Census Bureau, Census 2000

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Table 2.3 Immigrant Status and English Language Ability

Community	% Foreign-Born*	% Recent Immigrant (1990-March 2000)*	% Speaking English "Less Than Very Well"
Massachusetts Total	12	5	13
Arlington	12	6	8
Belmont	14	6	9
Boston@	26	13	27
Burlington	15	7	9
Cambridge	26	15	16
Chelsea	36	21	54
Everett	22	11	27
Lexington	16	6	7
Malden	26	13	24
Medford	16	6	16
Melrose	6	2	5
Reading	4	1	3
Revere	21	10	24
Somerville	29	14	30
Stoneham	8	2	8
Wakefield	5	1	3
Watertown	20	8	16
Wilmington	5	1	3
Winchester	11	3	5
Winthrop	9	4	7
Woburn	10	4	21

**% of population 5 years of age and older.*
@ Includes all of Boston, not just East Boston and Charlestown.
Source: 2000 Census of Population